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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 09/976,559
Filing Date: October 12, 2001
Appellant(s): MITRA, PRADIP

Douglas A. Sorensen
For Appellant

EXAMINER'S ANSWER

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This is in response to the appeal brief filed 28 January 2005 appealing from the Office action mailed 21 July 2004.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

The following is a listing of the evidence (*e.g.*, patents, publications, Official Notice, and admitted prior art) relied upon in the rejection of claims under appeal.

4,566,918	IRVINE *et al.*	1-1986
4,956,304	COCKRUM *et al.*	9-1990

5,466,953	ROSBECK *et al.*	11-1995
5,998,235	MITRA	12-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Issue 1: claims 28, 29, 31, 32, 41, 42, and 44-46 are rejected under 35 U.S.C. 102(b) as being anticipated by Cockrum et al. (US 4,956,304).

In regard to claim **41**, Cockrum *et al.* disclose (Figs. 1 and 4A-4K) a radiation detector comprising:

(a) a substrate (is inherent in an epitaxially grown radiation absorption layer 12; column 2, line 68 to column 3, line 4);

(b) a radiation absorption layer (12) above the substrate;

(c) a passivation layer (18) above the radiation absorption layer (12);

(d) a doped region (14) in the radiation absorption layer (12) and inherent in a thermal diffusion process (column 6, lines 15-62) is an extension of the doped region through the passivation layer (18); and

(e) an electrical contact (20) to provide electrical contact to the doped region (14).

In regard to claim **42** which is dependent on claim 41, Cockrum *et al.* also disclose (column 2, line 68 to column 3, line 4) that the absorption layer (12) includes HgCdTe.

In regard to claim **44** which is dependent on claim 41, Cockrum *et al.* also disclose (column 6, lines 56-62) that a dopant of the doped region is p-type.

In regard to claim **45** which is dependent on claim 41, Cockrum *et al.* also disclose (column 6, lines 56-62) that a dopant of the doped region is arsenic.

In regard to claim **46** which is dependent on claim 41, Cockrum *et al.* also disclose (column 2, line 68 to column 3, line 4) that the radiation absorption layer (12) is adapted to detect infrared radiation.

In regard to claims **28**, **29**, **31**, and **32**, Cockrum *et al.* is applied as in claims 41, 42, 44, and 45 above. Cockrum *et al.* also disclose (column 6, lines 15-62) forming a patterned doping layer (30 in Figs. 4E and 4F) above the passivation layer (26 in Figs. 4C-44E) and driving (*i.e.*, thermally diffusing) dopant from the patterned doping layer (30 in Figs. 4E and 4F) into the radiation absorption layer (12 in Fig. 4F) to form a doped region (14a or 14b in Figs. 4G-4K).

<u>Issue 2</u>: claims 1, 2, 4, 5, 14, 15, and 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum et al. (US 4,956,304) in view of Rosbeck et al. (US 4,961,098).

In regard to claims **1**, **2**, **4**, and **5**, Cockrum *et al.* is applied as in claims 28, 29, 31, and 32 above. The method of Cockrum *et al.* lacks forming a wider bandgap layer between the radiation absorption layer and the passivation layer. However, compositional grading is well known in the art. For example, Rosbeck *et al.* teach (column 3, line 54 to column 4, line 4) that compositional grading (*i.e.*, a plurality of layers wherein bandgap for each layer changes) provides the advantage of reduced leakage current and increased diode impedance as compared with a constant bandgap layer. Therefore it would have been obvious to one having ordinary skill in the art at the

time of the invention to compositional grade the absorption layer (12) in the method of Cockrum *et al.* by forming a wider bandgap layer between the radiation absorption layer and the passivation layer, in order to reduce leakage current and increase diode impedance.

In regard to claims **14**, **15**, and **17-19**, Cockrum *et al.* in view of Rosbeck *et al.* is applied as in claims 1, 2, 4, 5, and 46 above.

Issue 3: claims 30, 33, 35-40, 43, 47, and 49-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum et al. (US 4,956,304) in view of Mitra (US 5,998,235).

In regard to claim **30** (which is dependent on claim 28) and claim **43** (which is dependent on claim 41), the method and detector of Cockrum *et al.* lacks that the absorption layer includes $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$. Mitra teaches (column 3, line 54 to column 4, line 10) that an absorption layer comprising $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$ have a infrared response equivalent to HgCdTe but with the advantage of reducing defects. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to provide $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$ for the absorption layer (12) in the method and detector of Cockrum *et al.*, in order to reduce defects.

In regard to claims **33**, **35-37**, **39**, and **40**, Cockrum *et al.* is applied as in claims 28, 29, 31, and 32 above. The method of Cockrum *et al.* lacks that the absorption layer and the passivation layer are formed in situ by alternating layers of a first material (*i.e.*, HgTe) and a second material which is $Cd_{1-y}Zn_yTe$, where y (*e.g.*, y=0.056) is selected to provide a target lattice constant, the composition of the absorption layer and the

passivation layer being determined by the relative thicknesses of the layers of the first and second materials and, after deposition of the layers of first and second materials, annealing the first and second materials to produce an alloy of the first and second materials. Mitra teaches (column 3, line 54 to column 4, line 16) that a layer formed from annealing alternating HgTe and $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$ layers have the advantage reduced defects within the layer. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to anneal alternating HgTe and $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$ layers to form the absorption layer (12) and the passivation layer (18) in the method of Cockrum *et al.*, in order to reduce defects.

In regard to claim **47**, **49-51**, **53**, and **54**, Cockrum *et al.* is applied as in claims 33, 35-37, 39, and 40 above.

In regard to claim **38** (which is dependent on claim 33) and claim **52** (which is dependent on claim 47), Mitra is applied as in claims 30 and 43 above.

Issue 4: claims 3 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum et al. (US 4,956,304) in view of Rosbeck et al. (US 4,961,098) as applied to claims 1 and 14 above, and further in view of Mitra (US 5,998,235). In regard to claim **3** (which is dependent on claim 1) and claim **16** (which is dependent on claim 14), Mitra is applied as in claims 30 and 43 above.

Issue 5: claims 6, 8-13, 20, and 22-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum et al. (US 4,956,304) in view of Rosbeck et al. (US 4,961,098) and Mitra (US 5,998,235).

In regard to claims **6**, **8-10**, **12**, and **13**, Cockrum *et al.* in view of Rosbeck *et al.* is applied as in claims 1, 2, 4, and 5 above and Mitra is applied as in claims 33, 35-37, 39, and 40 above.

In regard to claims **20**, **22-24**, **26**, and **27**, Cockrum *et al.* in view of Rosbeck *et al.* and Mitra is applied as in claims 6, 8-10, 12, and 13 above.

In regard to claim **11** (which is dependent on claim 6) and claim **25** (which is dependent on claim 20), Mitra is applied as in claims 30 and 43 above.

<u>Issue 6</u>: *claims 33, 34, 37, 39, 40, 47, 48, 51, 53, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum et al. (US 4,956,304) in view of Irvine et al. (US 4,566,918).*

In regard to claims **33**, **34**, **37**, **39**, and **40**, Cockrum *et al.* is applied as in claims 28, 29, 31, and 32 above. The method of Cockrum *et al.* lacks that the absorption layer and the passivation layer are formed in situ by alternating layers of a first material (*i.e.*, HgTe) and a second material (*i.e.*, CdTe), the composition of the absorption layer and the passivation layer being determined by the relative thicknesses of the layers of the first and second materials and, after deposition of the layers of first and second materials, annealing the first and second materials to produce an alloy of the first and second materials. Irvine *et al.* teach (column 2, lines 50-59; column 3, lines 34-44) that a layer formed from annealing alternating HgTe and CdTe layers have the advantage controlling the lateral uniformity of x. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to anneal alternating HgTe and

CdTe layers to form the absorption layer (12) and the passivation layer (18) in the method of Cockrum *et al.*, in order to control the lateral uniformity of x.

In regard to claim **47**, **48**, **51**, **53**, and **54**, Cockrum *et al.* is applied as in claims 33, 34, 37, 39, and 40 above.

Issue 7: claims 6, 7, 10, 12, 13, 20, 21, 24, 26, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum et al. (US 4,956,304) in view of Rosbeck et al. (US 4,961,098) and Irvine et al. (US 4,566,918).

In regard to claims **6**, **7**, **10**, **12**, and **13**, Cockrum *et al.* in view of Rosbeck *et al.* is applied as in claims 1, 2, 4, and 5 above and Irvine *et al.* is applied as in claims 33, 34, 37, 39, and 40 above.

In regard to claims **20**, **21**, **24**, **26**, and **27**, Cockrum *et al.* in view of Rosbeck *et al.* and Irvine *et al.* is applied as in claims 6, 7, 10, 12, and 13 above.

(10) Response to Argument

Appellant argues (last paragraph on pg. 6 of appeal brief filed 28 January 2005) that Cockrum *et al.* show that the mask layer 26 is removed and that this step patterns doping source layer 30 and removes the portion of layer 30 above passivation layer 18. Examiner respectfully disagrees. Cockrum *et al.* state (column 6, lines 15-62) "Referring to FIGS. 4a-4k there is illustrated another method of the invention which forms by a diffusion process p-n diode junctions which lie under the passivation layer 18 ... In step 4e a relatively thin source layer 30 of a suitable n-type dopant is deposited over the surfaces of the photoresist layer 26 and the surfaces exposed within the openings ... FIG. 4f shows the structure after the photoresist layer is removed, thereby

rejecting the overlying source layer 30 except where it contacts the layer 12 and the exposed surfaces of the passivation layer 18. A heating process is thereafter performed which diffuses indium from the source layer 30 into the p-type layer 12, thereby converting the p-type material and forming the diffused n-type regions 14a and 14b. As can be seen in FIG. 4g, diffused the n-type regions 14a and 14b extend laterally outwards and the resultant p-n junctions underlie the passivation layer 18 ... As described above, the mask layer 26 is removed in step 4f before the step of diffusing is accomplished ... It can be appreciated that, depending on the type of material which comprises the mask layer 26, the diffusion step may be accomplished before the removal of the mask layer 26". The key phrases are "n-type regions 14a and 14b extend laterally outwards and the resultant p-n junctions underlie the passivation layer 18" and "the diffusion step may be accomplished before the removal of the mask layer 26" Therefore, Cockrum *et al.* expressly teach discrete n-type regions (with the resultant p-n junctions underlie the passivation layer 18) formed by driving dopant (*i.e.*, thermal diffusion) from a patterned source layer 30 formed above the passivation layer 18 <u>before</u> the removal of the mask layer 26.

<u>Issue 1:</u>

Appellant argues (section B.1 on pg. 8-9 of appeal brief filed 28 January 2005) that Cockrum *et al.* do not show or suggest "forming a patterned doping layer above the passivation layer". Examiner respectfully disagrees. Pattern is defined[1] as "to furnish, adorn, or mark with a design". It should be noted that independent claim 28 does not

[1] Merriam-Webster's Collegiate Dictionary 10th Edition.

require any specific design of the doping layer. Thus a doping layer of <u>any</u> design formed above the passivation layer would anticipate this element recited in independent claim 28. As discussed above, Cockrum *et al.* expressly teach thermal diffusion from a patterned source layer 30 formed above the passivation layer 18 in order to form <u>discrete</u> n-type regions with the resultant p-n junctions underlie the passivation layer 18. Therefore, the Cockrum *et al.* reference expressly or inherently show every limitation of the claim.

Appellant also argues (section B.2 on pg. 9-10 of appeal brief filed 28 January 2005) that Cockrum *et al.* do not disclose a doped region extending through the passivation layer into the radiation absorption layer since neither Cockrum *et al.* nor Rosbeck *et al.* show or suggest "forming a patterned doping layer above the passivation layer". Examiner respectfully disagrees. As discussed above, Cockrum *et al.* expressly teach thermal diffusion from a patterned source layer 30 formed above the passivation layer 18 in order to form discrete n-type regions with the resultant p-n junctions underlie the passivation layer 18. Cockrum *et al.* also disclose (column 2, line 67 to column 3, lines 21) that both the radiation absorption layer (12) and the passivation layer (18) comprise $Hg_{1-x}Cd_xZnTe$. A thermal diffusion from a patterned source layer 30 into $Hg_{1-x}Cd_xZnTe$ would drive dopant from the patterned source layer 30 into both the $Hg_{1-x}Cd_xZnTe$ radiation absorption layer (12) and the $Hg_{1-x}Cd_xZnTe$ passivation layer (18). Thus, Cockrum *et al.* disclose a doped region extending through the passivation layer into the radiation absorption layer. Therefore, the Cockrum *et al.* reference expressly or inherently show every limitation of the claim.

Issue 2:

Appellant argues (section C.1 on pg. 10 of appeal brief filed 28 January 2005) that neither Cockrum *et al.* nor Rosbeck *et al.* show or suggest "forming a patterned doping layer above the passivation layer". Examiner respectfully disagrees for the reasons discussed above.

Appellant also argues (section C.2 on pg. 10-11 of appeal brief filed 28 January 2005) that neither of the cited references show or suggest a "doped region extending through the passivation layer into the wider bandgap layer and the radiation absorption layer" since neither Cockrum *et al.* nor Rosbeck *et al.* show or suggest "forming a patterned doping layer above the passivation layer". Examiner respectfully disagrees that neither Cockrum *et al.* nor Rosbeck *et al.* show or suggest "forming a patterned doping layer above the passivation layer" for the reasons discussed above.

Further, the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). In this case, Rosbeck *et al.* was cited as teaching (column 3, line 54 to column 4, line 4) that compositional grading (*i.e.*, a plurality of layers wherein bandgap for each layer changes) provides the advantage of reduced leakage current and increased diode impedance as compared with a constant bandgap layer. Thus it would have been obvious to one having ordinary skill in the art at the time of the

invention to compositional grade the absorption layer (12) in the method of Cockrum *et al.* by forming a wider bandgap layer between the radiation absorption layer and the passivation layer, in order to reduce leakage current and increase diode impedance. Therefore the combination of the references would have suggested to those of ordinary skill in the art a "doped region extending through the passivation layer into the wider bandgap layer and the radiation absorption layer".

Issue 3:

Appellant argues (section D on pg. 11-13 of appeal brief filed 28 January 2005) that the cited references do not show or suggest "forming a patterned doping layer above the passivation layer" or a doped region that extends through the passivation layer into the radiation absorption layer. Examiner respectfully disagrees for the reasons discussed above.

Issue 4:

Appellant argues (section E on pg. 13-14 of appeal brief filed 28 January 2005) that the dependent claims are allowable for the same reason that the independent claim is allowable. Examiner respectfully disagrees since the independent claim is not allowable for the reasons discussed above.

Issue 5:

Appellant argues (section F on pg. 14-15 of appeal brief filed 28 January 2005) that the cited references do not show or suggest "forming a patterned doping layer above the passivation layer". Examiner respectfully disagrees for the reasons discussed above.

Issue 6:

Appellant argues (section G on pg. 15-17 of appeal brief filed 28 January 2005) that the cited references do not show or suggest "forming a patterned doping layer above the passivation layer". Examiner respectfully disagrees for the reasons discussed above.

Issue 7:

Appellant argues (section H on pg. 17-18 of appeal brief filed 28 January 2005) that the cited references do not show or suggest "forming a patterned doping layer above the passivation layer". Examiner respectfully disagrees for the reasons discussed above.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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SL
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